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Superorbital variability of X-ray and radio emission of Cyg X-1 - I. Emission anisotropy of precessing sources

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Abstract

We study theoretical interpretations of the ~150-d (superorbital) modulation observed in X-ray and radio emission of Cyg X-1 in the framework of models connecting this phenomenon to precession. Precession changes the orientation of the emission source (either disc or jet) relative to the observer. This leads to emission modulation due to an anisotropic emission pattern of the source or orientation-dependent amount of absorbing medium along the line of sight or both. We consider, in particular, anisotropy patterns of blackbody-type emission, thermal Comptonization in slab geometry, jet/outflow beaming and absorption in a coronal-type medium above the disc. We then fit these models to the data from the Rossi X-ray Timing Explorer All-Sky Monitor, CGRO BATSE and the Ryle and Green Bank radio telescopes, and find relatively small best-fitting angles between the precession and the orbital planes, ~10°- 20°. The thermal Comptonization model for the X-ray emission explains well the observed decrease in the variability amplitude from 1 to 300 keV as a result of a reduced anisotropy of the emission due to multiple scatterings. Our modelling also yields the jet bulk velocity of ~(0.3-0.5)c, which is in agreement with the previous constraint from the lack of an observed counterjet and the lack of short-term X-ray/radio correlations. © 2007 RAS.

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Keywords

Accretion, accretion discs, Radiation mechanisms: thermal, Radio continuum: stars, Stars: individual: Cyg X-1, X-rays: binaries, X-rays: stars